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Food Manufacture

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The editor will be glad to consider contributions from those engaged in the Food Industry. Articles intended for publication should be of a practical nature and accompanied by photographs or drawings whenever possible.

May, 1927

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Fruit Storage.

THE DEPARTMENT of Scientific and Industrial Research (Food Investigation) has just issued a report on the gas-storage of fruit. The report is a record of experiments on the effects produced by various proportions of carbon dioxide and oxygen in the atmosphere upon the rate at which fruits ripen and age in storage, and hence upon the length of their storage life. These experiments have established the important fact that gas-storage by the method of restricted and controlled ventilation, operated to maintain 10 per cent. of carbon dioxide (and 11 per cent. of oxygen), is most effective at a temperature of about 50° F. Under these conditions the storage life of apples may be doubled, without in any way impairing the taste and appearance of the fruit.

It is common knowledge that living fruit and vegetables consume oxygen and give out carbon dioxide, and that the latter has a retarding effect upon the vital activity of plant organisms. Therefore, during storage in an unventilated chamber the proportion of carbon dioxide rises and retards the ripening process. There are, however, certain conditions of atmospheric composition and temperature which give the best results. Hence arises the necessity for bringing these factors under control. The simplest method, and the one adopted by the experimenters, is to regulate ventilation. But this is crude, and it does not take into account the important factors of humidity and air-circulation. Further work will aim at devising means for regulating the concentrations of oxygen and carbon dioxide independently, as well as the relative humidity and the circulation of the air within the chamber. The work carried out in America on the control of relative humidity, temperature and air circulation within lumber-drying kilns should provide many useful suggestions.

Bakers in Trouble.

In its usual high-spirited way, the *U.V.C. Outlook* urges the bakers to adopt a more progressive attitude. The baking trade seems hedged in by its friends and its enemies. Its enemies say that bread is bad and that bakers are worse, and its friends say that apathy is the biggest peril to the trade. The result is a certain amount of depression, poor profits, and bad tempers.

From this it would appear that amongst the bakers' friends may be reckoned those who complain that many underground bakehouses are badly ventilated, and that they are infested with crickets and beetles; often, through lack of space, the bread is piled on the floor. The need for soap and towel is recognised by the Home Office which has just issued the Bakehouses Welfare Order, 1927, to come into operation on May 1, 1927. This Order requires bakehouses to be equipped with suitable washing facilities, including a constant supply of warm water, soap, and clean towels, and also suitable accommodation for clothing, together with adequate arrangements for drying

the clothing if wet. The main object is the prevention of dermatitis among workers handling flour and sugar.

The other day we were asked by a correspondent, evidently alarmed at the prospect of a tax on cats, if we thought that the small baker who keeps a cat to reduce the mice would get an exemption. Our correspondent cites the parallel case of the blind man and his dog.

Tinless Cans.

Reviewing the research work carried out by the Washington Laboratory, Dr. Kohman refers to an inquiry into the possibility of using tinless cans. The question arose as to whether tin intensifies the corrosion of iron in certain canned fruits because of the electric couple set up between them. It was found that tinless cans formed hydrogen to a greater extent than the tinned cans, but that the latter perforated to a much greater extent. Some products attack the tin more readily, whereas others have a preference for the iron. The Washington chemists were able to control this preference, causing either tin or iron to be attacked at will, by addition of certain substances in small quantities. This would appear to be the first step towards eliminating corrosion altogether. The net result so far is that tinned cans are found to be more serviceable from the commercial standpoint.

Dr. Kohman considers that lacquers may be developed which for certain products will make tin unnecessary. Experiments are being made with cans of stainless steel, but there is considerable difficulty in moulding cans out of this material.

A New Quadruped.

The meat by-products industry is agitated at the sudden appearance in America of a hitherto unknown, and truly remarkable, quadruped known as the "goldbeater." Our authority is the following extract from a Midland daily paper: "The American airship *Shenandoah*, which is 680 feet long and 79 feet in diameter, contains 20 gas cells of cotton cloth each lined with the skin of a goldbeater—a small American quadruped. Over these cells is another waterproof covering. But as over 500,000 animals were necessary to line these cells, the chemist is now experimenting with viscose, which in thin threads is artificial silk." Statements of this kind illustrate the danger of misrepresentation to which the food industry is constantly exposed. Unfortunately, they are not often quite so amusing and harmless as this one.

English Fruit Canning.

The Lynn Road fruit-canning factory at Wisbech, belonging to the Wisbech Produce Canners, Ltd., is to be supplemented by two other factories, one at Wisbech and the other at Evesham. The former is being equipped for pea and vegetable canning; the latter for fruit and vegetable canning. Mowing, together with mechanical extraction, cleaning, and grading are expected to reduce the harvest costs in the case of peas from £6 or £7 an acre to £2 or £3. The Company is financed by local fruit-growers.

The extent to which we are at present dependent upon U.S.A. for canned foods does not appear to be realised. We give the following figures as proof of the very great scope which exists in this country, as well as in Canada, for the production of canned products. With the exception of peas and corn, the exports from the United States of canned vegetables for 1926 as compared with 1925 showed an increase. The increase for beans was 76 per cent.; soups, 42 per cent.; tomatoes, 39 per cent.; asparagus, 14 per cent.; other vegetables, 58 per cent. Attention is drawn to the fact that we absorbed 63 per cent. of the canned beans exported, 11 per cent. of the asparagus, 14 per cent. of the soups, 13 per cent. of the corn, 6 per cent. of the peas, and 33 per cent. of other vegetables. In all these commodities Canada figures prominently as an importer. The exports of canned beef have increased 22 per cent., and of canned pork, 37 per cent.; we take 64 per cent. of the former and 82 per cent. of the latter. As for other products, we take 45 per cent. of the salmon exported; 8 per cent., sardines; 92 per cent., apples and apple sauce; 83 per cent., apricots; 11 per cent., cherries; 80 per cent., peaches; 87 per cent., pears; 33 per cent., pineapples; and 77 per cent. of other fruit. Shipments of evaporated milk to the U.K. and to Germany declined considerably. In the case of Germany, Tariff changes caused the set-back, but in an effort to retain the market some American producers have established German factories. A drop in shipments to Argentina was due largely to new food regulations, which require sardines to be packed with tomato sauce in lacquered or enamelled cans. The large exports of beans and soups were probably due to intensive export activities by a few producers or shippers.

Fish Canning.

The fish-canning industry of the Canadian West Coast is forging ahead. The British Columbia Fishing and Packing Company, of Vancouver, is erecting a large cannery at Johnston Channel, near Ocean Falls. On Vancouver Island the Canadian Fishing Company is to erect a fish-reduction plant with a capacity of 125 tons of pilchards a day, as well as a salmon cannery, and also an extension to the cannery at Butedale, on Princess Royal Island, to treat salmon offal. On Pender Island the Pender Island Fish Products Company will erect a reduction plant to use hydro-electric power. With the development of the market for fish oil, fish meal, and fertiliser, Pender Island is expected to be the scene of considerable activity.

Marketing Canned Goods.

Mr. W. S. Crawford, of the Empire Marketing Board, states that our place in world commerce is being imperilled through lack of the will to sell. We manufacture superbly as professionals, but we market as bungling amateurs. We can create new demands by finding out what our neighbours want and what they can be made to want. There should be more activity in searching for and in creating new markets.

In this connection it is interesting to note that "distribution research" was much discussed at the Atlantic City Convention. The National Canners' Association will institute a systematic study of distributing and marketing problems. It will probably begin with what might be called a "canned-goods consumption survey," with the object of answering questions such as those put to the Convention by the President, Mr. H. W. Phelps. Evidently the American canners feel that the time is ripe for the collection of such statistics as will enable them to map out the country into districts according to the consumption of canned foods, both quantitatively and qualitatively. Presumably the next step will be to ascertain causes, and, finally, to devise means of correcting deficiencies wherever these are found to occur.

Something of this kind has already been attempted by the National Canners' Association, acting conjointly with the Department of Commerce. The object was to find out what the average housewife thought about canned foods—to get "a cross-section of the consumer's mind." The results were not very conclusive, since reliance was placed on a questionnaire distributed over a limited area. However, some interesting points were brought to light. It was found that the winter consumption was two to four times greater than the summer consumption. There was a general agreement that canned foods were convenient. As the standard of living improves, the percentage of canned foods consumed decreases. Opinion as to the relative food value of fresh and canned fruits and vegetables was not distinctive; only about half the users being willing to express a distinct preference. Practically all the latter believed that the fresh products had the higher food value. This clearly calls for correction! On the question of relative price, there seemed to be no very definite opinion. Data were collected as to whether any difficulty from deterioration was experienced, and only a very small number expressed prejudice on this point. It was also found to be the general custom to buy canned goods by brand, very few housewives being aware that there are different grades of these products.

Tropical Food Factories.

Tropical countries are becoming more independent of imported food products. Brazil, for instance, is giving increasing attention to fruit cultivation and preserving, but the local products are said to be inferior, and British jams still find a good market among foreign residents. The high lying parts of Brazil are eminently suitable for the cultivation of the European types of fruits. At Pocos de Caldas are several quite up-to-date preserving factories, and the largest of these is beginning to have a very considerable turnover. Gooseberries and red currants are extensively grown in the State of Paulo, as also in the Campos Do Jordao district.

In Peru the firm of Lizandro Quezada and Caisson has obtained from the Ministry of Agriculture a ten years' monopoly for the manufacture of tomato catsup and of preserved tomatoes. At Yumuri-Tale, near Matanzas in Cuba, a factory has been erected for the manufacture of guava pastes, jellies, marmalade, and canned fruit, in addition to mango marmalade, tomato sauce, and candied peel. The entire production will be absorbed within the country.

Co-operative Advertising.

Researches into the applications of gelatine in the confectionery industry are being carried out by the Mellon Institute. It will be remembered that during the past few years a number of American concerns manufacturing gelatine have subsidised an exhaustive inquiry into the properties and applications of gelatine, and that this work was carried out under the direction of Dr. Downey. The results have been given a great deal of publicity in America, and have undoubtedly assisted sales. It affords a striking example of co-operative advertising scientifically conducted. The first step was to lay down a solid foundation of facts relating to the properties of the product; the next, to explore all possible applications, and then, upon this, to erect the glorified structure of sales-arguments and various other forms of appeal. There is little doubt that in the near future we shall see a very rapid growth in this policy. Preserved or manufactured foodstuffs are particularly adapted to it; at the Canners' Convention a scheme of co-operative advertising for preserves was taken up with great enthusiasm.

Gelatine.

In the case of gelatine, the sales-arguments were built round the basic properties of the product; it is a protective colloid and an emulsifying agent (a stabilising agent), a gelatising agent, a readily digestible protein, and, more important still, a food that renders other foods easier of digestion. As a stabilising agent, its peculiar property of inhibiting coagulation (or crystallisation), and of stabilising emulsions, is made use of in modifying the curding of milk, in "killing the grain" of certain kinds of confectionery, and in imparting a smooth, velvety texture to ice-cream. McCollum and his co-workers have shown how it promotes the digestion and absorption of certain types of foods.

Marshmallows.

The first subject for research at the Mellon Institute is the marshmallow. Here, too, gelatine plays an important part. The views as to its properties and methods of use most suitable for marshmallow manufacture are at present very conflicting. Thus more definite data are required on best jelly strength, best rate of setting, the effects of part or complete substitution by other emulsifying agents, the most satisfactory chemical and bacteriological testing procedure, and the relations between speed of beating and jelly strength. But marshmallow research by no means begins and ends with gelatine. It requires to be extended to include the other factors which influence the colour, texture, and other physical properties of the confection—such factors as batch composition, speed and temperature of beating, and conditions of drying. It would be instructive to examine the various common makes of marshmallow as regards their percentage porosities, and the shape and size of their air-cells. A step further would be to correlate this internal structure with physical properties on the one hand, and with composition, as well as manufacturing operations, on the other.

"Death on the Doorstep."

It is always instructive and entertaining to see ourselves in the American mirror. Accordingly we extract the following from an article contributed to the *Glass Container* by an overseas visitor to London. After dealing more particularly with the English methods of distributing milk—methods that "came out of the Ark" and result in "death on the doorstep"—the writer concludes that the evidence indicates "that although the class of English people with family trees and pedigrees going back to the days of William the Conqueror may have more polish in manners, etiquette, tact, and graceful hospitality than most Americans of pioneer stock, the latter know far more about such even more important matters as hygiene, sanitation, and purity of the food supply than the former mentioned. The British eat on the principle of 'no questions asked,' for they seldom inquire as to the origin of food products, although of late the Ministry of Health has been conducting a vigorous campaign about the use of preservatives."

Preservatives.

Under the new regulations benzoic acid may be used as a preservative for pickles, sauces, coffee extract, brewed ginger-beer, sweetened mineral waters, non-alcoholic wines, cordials, and fruit-juices. The appearance of Ministry of Health Report No. 39, by Dr. G. W. Monier-Williams, on the determination of benzoic acid in foodstuffs, is most opportune. The Report is concise and comprehensive, and deals in turn with the various methods proposed and used in the past for the extraction, purification, and identification of benzoic acid, together with a new method worked out by the author and applicable to fruit and vegetable products. The subject has been treated very thoroughly and critically, and furnishes a good example of the difficulties and pitfalls which surround the analyst in making any organic determination of this nature.

The book is, of course, a necessary corollary to the new Preservative Regulations, and one may express the earnest wish that the Ministry of Health will see fit to sponsor a similar volume dealing with sulphurous acid. Those chemists who are concerned with the estimation of this preservative are experiencing great difficulty in their search for an accurate and reliable method. Various methods give discordant results; moreover, sulphurous acid is frequently found where none has been added, and, again, the amount found on analysis may not agree with the amount previously added to the foodstuff. In this connection the data obtained by Dr. Drake-Law, recorded in the present issue, are very instructive. It is desirable that these be extended by other workers in order to obviate wastage of effort, and generally to arrive at a satisfactory solution as soon as possible. What is urgently required is an official and standard method which shall at least give uniform, if not perfectly accurate, results.

American Finance.

In spite of the falling off of exports and of the increase of imports, the flow of gold into the United States expanded in 1926. This appears to be due partly to the increased receipts of interest and dividends from previous American investments in foreign countries, and partly to the building up of foreign gold balances in American banks in an effort to stabilise exchange. During the past six years the investment of American capital abroad has doubled —from 553 million dollars in 1921 to 1,168 million dollars in 1926. The *Guaranty Survey* states that most of the Government loans are funded, and the service on these loans, together with increasing payments on account of private debts, must sooner or later be reflected in the United States' foreign trade, and as yet there is no sign of cessation in the world's accumulation of indebtedness to the United States with its attendant effect upon the country's foreign trade in the future.

Paper Containers.

Increased interest is being shown in the use of paper containers for foodstuffs. They are being used for milk, lard, bacon, confectionery, and fruit, but the scope is unlimited. This form of packaging has several obvious advantages, such as the safeguarding of purity and quality, convenience in handling, elimination of waste, and the facilities offered for

attractive advertising. The idea has been applied by one firm to the packing of block chocolate, which is put up in cartons similar in shape to the familiar cigarette packet. In America bacon is being sold in greaseproof cartons, with one side transparent for purposes of display. An appeal through another channel was made by a coffee company by having the name of the brand printed on one side of the can and upon the other side the word "sugar," "salt," etc., thus ensuring the containers a more or less permanent life in the kitchen.

Efficiency of Meat Packing.

An analysis of census figures for the year 1925, recently issued by the U.S. Dept. of Commerce, indicates that the American meat packing industry pays out for live stock, fuel, electric power, and containers more than 86 per cent. of the plant value of finished products. The remaining 14 per cent. is absorbed by wages, salaries, interest, rent, depreciation, taxes, insurance, advertising, research, and a small manufacturing profit. For the year 1923 the corresponding figures were 84 per cent and 16 per cent. respectively, thus indicating an increase in the efficiency of packing operations.

Glass in Foods.

The Ministry of Health Report No. 37, by G. C. Hancock, C.B.E., M.R.C.S., on the occurrence of glass fragments in foods packed in glass containers finally disposes of the "glass poisoning" bogey. From time to time, certain sections of the medical and trade Press have pointed to glass containers as a source of danger to public health, even to the extent of causing gastric and intestinal ulcers, appendicitis, and cancer. It has been said that powdered glass might produce serious symptoms, and even death.

However, setting on one side opinions, suspicions, and prejudices, a thoroughly scientific inquiry can, in the first place, find no direct medical evidence that powdered glass taken in relatively small quantities has produced injury, particularly if swallowed with food. The glass is coated by food and by stomach and intestine secretions, and is thereby rendered innocuous. Comparatively large particles of glass in food are very rare occurrences. From inquiries made at four of the largest London hospitals, it appears that cases of injury from swallowing glass have been extremely rare. In fact, three of the hospitals could find no evidence whatsoever in their records. The Report cites cases of professional glass eaters and of attempts at suicide or homicide by administering powdered glass.

After carrying out searching experiments and exhaustive inquiries, the author of the Report cannot find any real objection to the use of glass containers as receptacles for food. The trace of glass dust which sometimes does occur is very probably derived from the dust of towns and other places, and is unconnected with the containers. It is there before the raw material is delivered to the factory. Similar dust of a glassy nature was found in butchers' meat and fresh fish in amounts very much greater than those in potted meat or tinned soup. A striking test, made by Mr. Munro, consisted in filling six glass jars with distilled water, capping them, and then processing them in the usual way; no glass particles could be detected. The Report notes the care taken by most food manufacturers to use good glass-ware, and to prevent fragments of glass gaining access to vessels during factory operations.

Cacao Butter Substitutes.

Two important papers were recently given before the Society of Public Analysts on the detection of cacao butter substitutes. Of the many substitutes, only coconut and palm kernel stearins, and the so-called illipé butters, are of commercial importance. The illipé butter that is sold for chocolate making is not the illipé butter from India, but is refined Borneo tallow prepared from Pontianak nuts. A few manufacturers use the "Siak" nut, which is a totally different species, and which produces a still harder fat. In France the use of Borneo tallow and other substitutes in plain chocolate is illegal. The Chambre Syndicale of the chocolate manufacturers of France offered in 1923 a prize of 20,000 francs for a method of detecting substitutes. Up to date they have not been able to award the prize, as they do not consider any of the processes offered are sufficiently satisfactory.

The detection of coconut and palm kernel stearins is simple, but that of the fats known commercially as illipé butter is difficult. Messrs. A. W. Knapp, J. E. Moss, and A. Melley propose an entirely new test, which consists in making use of the striking green colour of Borneo tallow. This colour is comparatively resistant to ultra-violet light, whereas the colour of cacao butter is readily bleached. Unfortunately this test cannot be extended to the detection of Borneo tallow in chocolate as the green colour does not seem to be quantitatively extracted by petroleum ether.

The method described by Messrs. H. W. Bywaters, F. T. Moggs, and C. J. Pool for the detection of illipé butter in chocolate is based on the fact that when illipé butter and cacao butter are cooled under the same conditions, the former becomes turbid at a temperature which may be ten degrees above the turbidity temperature of the latter. The turbidity temperature of a mixture of the two fats lies proportionately between those of the pure fats, thus enabling the portions of the fats present in any mixture to be determined. The authors described the apparatus and conditions most suitable in determining the turbidity temperature. They have estimated the percentage of illipé butter in a number of chocolates.

Overseas Regulations.

The reduced German import duties on pork, bacon, edible fats, milling products, and certain cereals, fixed by the Law of 10th July, 1926, have been continued in force until 31st July, 1927, by an Order dated 26th March, 1927.

The export from Australia of canned fruits is prohibited except in accordance with a licence issued by the Control Board. A maximum charge of a farthing for each thirty ounces of canned fruits exported is levied.

A Bill has been drawn up in the Union of South Africa for the purpose of consolidating and amending the laws relating to the importation and sale of foodstuffs. Food specially intended for invalids or infants which contains any preservative other than sugar or common salt or other substance which may be prescribed by regulation, may not be imported, manufactured, or sold.

Russia.

Four new preserving factories are to be erected in Russia. One, for fish and vegetables, will be located at Kertsch, and will cost 700,000 Rbl. A similar factory, for vegetables and tomatoes, at Hasaf-Jurt, and two smaller factories in the Komi district are projected.

Tinned Salmon and Sardines.

Chinese and Britishers agree in their affection for jam and for sardines. The Southern Chinese consume large quantities of jam. As for sardines, during the first nine months of 1926 nearly 61,000 dozen tins were imported into Shanghai. A little over 70 per cent. of the imports was shared between the United States and Norway. The Chinese also hold tinned salmon in high esteem.

The *Konserven-Zeitung* makes the following comments: "Tinned salmon are in great demand in South-West England, although more than 30,000 tons of fresh fish are annually brought into the harbours of that district. The demand is considerably increased during the summer months, probably owing to the influx of tourists. Generally speaking, red salmon is preferred to pink salmon. The product is imported from Siberia, Canada, and Alaska."

(*Continued on page 26.*)

Forthcoming Exhibitions

1927

June 17–*July* 2.—Manchester: *Daily Dispatch* Clean, Pure Food and Cookery Exhibition.

July 18–23.—London (Olympia): The Advertising Exhibition.

September 3–9.—London (Royal Agricultural Hall, Islington): International Bakers' and Confectioners' Exhibition.

September 17–23.—London (Royal Agricultural Hall, Islington): International Grocers' and Allied Trades' Exhibition.

October 4–13.—Sunderland: Sunderland Grocers' Exhibition.

October 12–22. London: International Exhibition of Inventions.

October 25–*November* 5.—Cardiff: New Health Exhibition.

October 28–*November* 5.—Manchester: Imperial Fruit Show.

November 5–15.—Norwich: Norwich Grocery Exhibition.

1928

January.—Leeds: Grocers and Allied Trades' Exhibition.

February 28–*March* 8.—Manchester: *Daily Dispatch* Chocolate and Sweets Exhibition.

Forthcoming Overseas Exhibitions

1927

April 23–*May* 2.—Rennes Annual Fair.

April 30–*May* 9.—Buda-Pest Fair.

May 1–8.—Zagreb Spring Fair.

May 7–15.—Tours Fair.

May 14–29.—Paris Fair.

May 21–*June* 2.—Limoges Industrial and Commercial Exhibiton.

Week beginning May 23.—Exposition of National Confectioners' Association, Atlantic City.

June 16–26.—Anjou Fair.

July 2–11.—Ljubljana International Sample Fair.

August 13–22.—Estonian International Exhibition Fair.

August 27–*September* 10.—Canadian National Exhibition.

August 28–*September* 5.—Zagreb General Samples Fair.

September 3–25.—Antwerp International Colonial Fair.

September 6–15.—Netherlands Industries Fair.

September 18–*October* 3.—Salonika International Fair.

September 19–*October* 1.—International Congress of Refrigeration.

November, first week.—Calabar Exhibition.

Scientific Control in the Food Industry

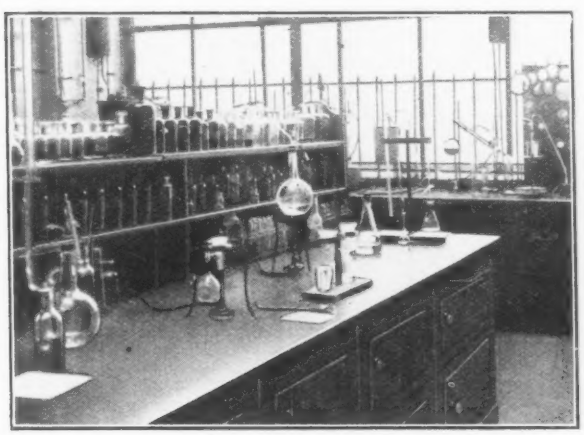
By J. VALENTINE BACKES, A.R.C.Sc., A.I.C., D.I.C.
Chief Chemist, Fullers, Ltd.

The very high standards in the quality and purity of foodstuffs nowadays insisted upon by the public, render it absolutely necessary for the manufacturer to make the fullest use of the latest methods of scientific control. The article below introduces the subject, and will be followed by others written by experts in the various branches of the food industry.

IN EVERY industry of to-day rapid advance is being made in the blending of scientific knowledge with manufacturing skill, with the result that the standards of perfection are constantly being raised to the benefit of both manufacturer and consumer.

The advance is a very real one in the food industry of this and other countries. It is, therefore, imperative that the individual manufacturer should realise the nature of this advancement and keep himself familiar with its progress.

While the manufacturer appreciates all the labour, technique, and research which is expended in production, does the consumer realise, or even try to visualise, what "lies behind" the product he purchases? It is to him a secondary consideration;



Main Analytical Laboratory, Messrs. Fullers, Ltd.

his sole interest lies in his demand, quite rightly, for quality and purity, and nowadays he has a very shrewd idea as to the definition of his request. There is little doubt that the consumer's ideas on these points are more exacting than those of the manufacturer, for the manufacturer complies with public demands, and in this way may be said to follow rather than to lead. The onus, therefore, lies on the manufacturer to pursue these growing demands of quality and purity, and to develop his resources to their fullest extent.

Quality, as is recognised by manufacturer and consumer alike, is variable. It is dependent on the type of raw material used, as well as on manufacturing technique and price demanded. This applies equally to all industries, and competition is based on the principle of maximum quality at the most reasonable price.

The demand for purity, however, is an extra liability laid upon the food manufacturer, and has the prior claim. Unlike "quality," the demand for purity cannot be dependent on any variable. If an article of food is stated to be pure, that statement must hold, irrespective of the type of raw materials used, or the method of manufacture, or the price demanded for that article. This cannot be too fully realised. The President of the Society of Public Analysts, in the course of a recent address, claimed that the purity of our food was higher than at any previous time. This, indeed, is a very encouraging state of affairs; the country looks to the food manufacturers to maintain this high standard, and to confer upon their goods that hallmark of purity which shall be second to none, and equal only to that of British "quality," which is the admiration of the world. In the effort to attain this ideal, manufacturers are recognising the growing necessity of Scientific Control in their factories. Scientific Control in a food factory aims at:

1. A Guarantee of Purity.
2. Maintenance of Quality.
3. Enforcement of Economy.

Guarantee of Purity

All food factories should be under analytical control in some form or other. This need not be on an elaborate scale. Obviously it depends on the size of the factory and the nature of the products. The space given up to a laboratory and the presence of a competent chemist on the staff is proving to be a valuable necessity rather than a luxury.

The analysis of all raw materials provides a check on every ingredient incorporated in the final product. The standards set for materials used in the manufacture of foodstuffs are high. The issue of the Preservatives, etc., in Foods Regulations has made them even higher, and the purity of the raw materials should have the closest attention of the food manufacturers. The analysis of raw material, the careful scrutiny of factory processes, the constant examination of goods at each stage of manufacture are focal points which all converge to the aim of purity, and give to the manufacturer that final assurance that his guarantee of purity really means something.

Maintenance of Quality

Quality is comparative. If a manufacturer wishes to maintain quality it is essential that he keeps apace with the times. What is good to-day may appear crude in the near future. Improvement is the key-

note to quality maintenance. The clever man is he who realises that there is still much to learn in his own particular trade. In the food industries in the past the "rule of thumb" methods played a big part. To-day many branches of the food industry are represented by a research association. These associations, supported by the manufacturers and the State, carry out research on a large scale for the benefit of that particular branch of the food industry they represent. It has always been said that "necessity"—*i.e.*, demand—"is the mother of invention." Nowadays it is equally true to say that science is the foster-mother, for whereas "demand" gives birth to the "child," it is "science" which develops it and brings it to maturity.

Many firms have their own research laboratories and staff, not only to tackle problems as they arise, to work out and inaugurate new processes, to assure by careful scrutiny that quality is maintained, but also to look for that "something" which is better.

Research conveys to some food manufacturers the idea of unnecessary expense with doubtful returns. No research which has been undertaken has failed to give valuable results. In many cases it has proved the impossibility of various ideas, but by so doing it has opened up fresh lines of thought, and so devised and developed processes on which the big industries are based. One has only to look at the present-day cellulose and artificial silk industry to realise what research has done in the course of a few years.

The food industry offers much ground to be explored and many problems to be solved. The fostering of scientific research is one way the manufacturer has of keeping in the competitive race, and even if he is not supreme, he can at least maintain his quality on a level with that of his successful competitor.

Enforcement of Economy

To some food manufacturers the chemist is considered a necessary nuisance. Strictly speaking, he is non-productive, and anything non-productive appears on the wrong side of the balance-sheet. But has the manufacturer given sufficient thought to the economies brought about in his works through scientific control? The cumulative effect of small improvements and alterations is not sufficiently realised. Take the question of fuel. The installation of apparatus to analyse the flue gases and to provide a guide for obtaining maximum combustion of the fuel has been known to save upwards of two tons of fuel per week on six boilers. Again, the analysis of lubricating oils and greases gives a guarantee and check on quality, and so adds life to the machinery. This is a big item in large factories where machinery plays a big part. Lack of efficient lubrication soon ruins a machine, and a poor oil can soon cause damage. The detection of adulteration of raw material acts as a guide to buying, and shows the manufacturer if he is getting value for money. These and many other examples go to show that taken over the year the amount saved by efficient control is considerable. Again the question of labour costs is one of the most important items in the food industry, and the solution to it is not usually found by speeding-up the workman. It must be realised that the pace at which a conscientious worker finds it best to work is the pace he should be allowed to work. It is *improvement of method* rather than increase of effort which produces a permanent increase of output and a lowering of labour costs. The term "permanent" here is used advisedly, for it is recognised that an increase in effort produces greater output for a time, but only at a cost which is to the disadvantage of both manufacturers and employés alike if persisted in.

Improvement of method, then, is the right way to bring about economy in labour and overhead expenses. Scientific knowledge can be a big ally in this direction. The scientifically trained man sees things at a different angle to the man not so trained, and is able to carry on investigations and improvements where the manufacturer must, of necessity, leave them. There are, indeed, few processes that have reached a stage of perfection not to justify investigation and improvement. Thus Scientific Control in a food factory is something to be fostered and encouraged, for it helps to lay the foundation of those ideals which every manufacturer seeks to attain.

Main Analytical and Research Laboratory, Messrs. Fuller, Ltd.

(*Continued from next page.*)

the foodstuff and the racial human *character* of the consumer in the countries I have recently visited, as I see them, particularly in Japan, the United States, and North Africa. Though general in its treatment, it is not a subject that the food manufacturer can afford to ignore, for it is the foundation upon which advertising should be built—the psychology of the people and their reactions after consumption of a mixed diet or of any particular foodstuff.

Man is a funny creature, and our women learned long ago never to tackle him until he was fed both adequately and well. There is much reason and wisdom in ancient adages and customs which we are only now reducing from expressions of age-old observations to simple psychological and physiological facts and needs. And in the East the woman, having less say in the feeding of her man and a smaller variety of goods to her hand, is in an inferior position to that of her Western sister who has made a study of man's reactions towards the meals she prepares or takes out of tins.

Food and Fortune

By ROBERT WHYMPER.

PART I

The psychology of human beings in relation to diet is a subject that has received surprisingly little attention, yet it lies at the very root of scientific advertising as it concerns the food manufacturer.

PROFESSOR H. E. ARMSTRONG, F.R.S., a name I take not in vain but in gratitude, used to tell me many years ago that I would never make a sound chemist until I could drink beer fluently and understand a glass of good port. With his kindly assistance I qualified for my profession, and, with much practice in the rules he laid down, I must by now be the soundest chemist in the country. But in my more mature years I added to the philosophy of science and living, taught me by my pastor and master, and I have learned since my early pupil days by sweet and bitter experience that consumption following appreciative understanding of the good foods of the world is at least equally influential in determining human character. Tell me the food he eats, and I will tell you what manner of man he is more surely than a Sherlock Holmes from his cigarette ash, than Chiro from his palm, or than Mr. Pelman from question and answer.

During the past five years I have wandered much in many countries of Europe, in the United States, in India and Japan, in Algeria and Tunisia. In most places my wanderings were stopped, except locally, for many weeks, in some for months, and in Japan for two years, in order that I might study the food problems. And my opinion is confirmed that my professor was right in endeavouring to form the plastic minds and bodies of his students by encouraging treatment with judicious doses of certain of the best foods and drinks that man can produce.

Maurice Maeterlinck, as an educator of the public mind in these matters, is the only one, so far, to have taken a leaf from Professor Armstrong's book, for, in his *Vie des Abeilles*, and his most recent book, *Vie des Termites*, the philosopher-poet has pointed out that the bee and the wrongly named white ant have from time immemorial known that properly selected foods, fed to a consumer in a strictly communistic society (for their kings and queens are the hardest and most productive workers in their realms, and are royal only by man's nomenclature), can change not only bodily proportions and appendages, but temperament, disposition, and even sex and fertility. Human science has not got this far, for it is young compared with the science of the termites, for example; and, because we are not yet of the putty-like consistency of which genuine communists must be made, we are not able to go quite so far as the bees and ants in altering quickly our immediate characteristics by selected diet. But we can do much, much more than most people realise, in controlling happiness and well-being by putting into practice the knowledge that has been acquired about our foodstuffs. Who, then, has this knowledge, and why has the world not heard of it before this? The answer is that it is specialised knowledge, and that those possessing it are so loth to impart the information they have acquired, that they are prepared to see ridiculous and alarmist statements appearing in the daily Press pass unchallenged rather than break silence. Further, there are not many reliable channels through which the specialist would care to pass on his knowledge. And it is here that FOOD MANUFACTURE may well fill a long-felt need, for, as I understand the purpose of the producers, it is intended to publish a monthly review of scientific facts relating to our foodstuffs in such a manner that even those not trained to scientific jargon can "read without tears" and understand.

The quality of our foods is of first importance! There is by common consent no such thing as bad beer, and it was only of good port that I spoke in the first paragraph; and, whilst we are grateful for the paternal care of the Home Office or Department of Hygiene in protecting us from frauds and adulterations, we know that the spread of knowledge is always far more efficacious than legislation in bringing about a desired and desirable new attitude of mind among the mass of people. Here, then, again seems to be the opportunity of FOOD MANUFACTURE —to broadcast to the manufacturers of our foodstuffs all information bearing upon the "fifty-seven varieties" of the industry in which they are engaged.

It was a simple diet of home-grown beef, home-made bread, and home-brewed beer that built the yeoman of England, for whose existence we have every reason to be profoundly thankful. "Where are the yeomen, the yeomen of England?" we may well cry or sing to-day. Ask also, Where are the barons of beef, the stone-milled flour, and that priceless strong four-ale of our ancestors? The beef, bread, and beer of old are gone: gone also are the yeomen with their heavy, powerful bodies and their sluggish minds. Instead, we have spiced meats and sausages, sweet cakes and whisky, and a new breed of Englishman is arising, more lithe in body and less slow in the up-take, given to Mustard Clubs and Daily Dozens and loudly advertising himself when he is a Froth-Blower. We may, with some justification, demand also which is the cause and which the effect of these changes, but those who reply must not forget that, as soon as effects have resulted, the new circumstances in turn become causes for fresh changes.

In a future issue I hope to be allowed to show the mutual relations existing between the *character* of

(*Continued on previous page.*)

The Spoilage of Foodstuffs

By E. H. CALLOW, B.Sc., Ph.D., A.I.C.

The spoilage of foodstuffs is a matter of the greatest importance to this country, which is largely dependent upon a continuous supply of imported products. The losses through spoilage are enormous, but they are capable of being very much reduced, if not altogether eliminated, by an extended campaign of scientific research.

EXISTENCE IN primitive communities has always been a precarious matter. At one period there is a superfluity of food, and at another there is a scarcity. Thus, the life of the North American Indians appears to have been an alternation between times of feasting and times of famine. One effect of the progress of civilisation has been the gradual elimination of famine, and this has been brought about by improved methods of food conservation.

In spite of all improvements, however, the loss of foodstuffs through various kinds of spoilage is still an enormous burden on the community. In Great Britain alone there may be losses of £100,000 or more every year in a single section of the food industry, so that the total losses throughout the world must amount to a tremendous figure.

There is no type of foodstuff that is not subject to wastage which could be prevented. In the past the use of chemical preservatives has enabled slip-shod methods to escape detection, and as the new preservative regulations come into operation a temporary increase in food spoilage will probably occur, until careless manufacturers learn better methods by bitter experience.

Causes of Spoilage

In order to prevent the deterioration of foodstuffs, the underlying causes of spoilage must be grasped. Although the ways in which spoilage can occur are extraordinarily numerous, yet the general causes are well known to science.

The first and most important cause is attack by micro-organisms. Not until the microscope was invented was it realised that life could exist as the infinitely small, and not until Pasteur had made his epoch-making discoveries was the importance of these microscopic organisms realised. Pasteur first showed that yeasts grew and multiplied during the fermentation of malt liquor in the brewing of beer. He also showed that certain diseases were caused by specific bacteria. Yeasts, moulds, bacteria and other organisms are very widely distributed in Nature, and are found, for instance, in air, water, soil, etc. It is therefore not surprising that they gain access to foodstuffs and cause spoilage. Hence it should be the aim of every person handling food to limit the access of micro-organisms to the food, and to provide conditions which restrict the growth of any organisms already present. Fortunately, the growth of micro-organisms can be checked in various ways.

Some foodstuffs are naturally more resistant than others; for instance, starchy foods, and other foods containing little water, are not prone to spoilage by micro-organisms. The danger of attack is always present if at any point in the food-mass the water content is increased above a critical value, which depends on the particular foodstuff. On the other hand, meat, fish, etc., which contain large quantities of water, are readily attacked. Among the foods which can be stored satisfactorily for long periods of time, owing to their dry character, are grains of all kinds, and it is certainly instructive to note that if their moisture content exceeds certain critical values—(*e.g.*, above 15 per cent. for some wheats)—they become liable to spoilage owing to the growth of moulds and bacteria.

Drying and Evacuating

The dryness of foodstuffs, then, is a protection from spoilage, and, of course, this fact has been utilised in all manner of ways from the preparation of biltong to that of bêche-de-mer. In this connection it cannot be too strongly emphasised that dried foodstuffs are not immune from the local attack of micro-organisms if at any point the water content is accidentally increased; thus a rain-spot may act as a focus of infection.

Cross-section of Apples, showing Internal Breakdown due to Storage.

The growth of micro-organisms cannot be entirely prevented by removing the air, because some of them grow without oxygen. These anaerobes include certain bacteria that are highly dangerous to man—(*e.g.*, the organisms causing tetanus and botulism).

How, then, can the growth of micro-organisms be effectively inhibited? We have already seen that drying is a possible method of preventing spoilage, but

few foodstuffs lend themselves to this treatment. Moreover, drying has the objection that it alters the character of the foodstuff, and often leads to the destruction of vitamins. Two methods of food preservation that are more generally applicable are the use of heat and the use of cold.

Sterilisation

It has long been known that all bacteria, moulds, yeasts, etc., can be destroyed by the application of a suitable degree of heat. In the canning industry foodstuffs are heated in tins with the object of destroying all such forms of life. This method is successful provided that the centre of the tin has been kept at a sufficiently high temperature for a sufficient length of time, and provided that no holes develop in the tin at a later date.

Refrigeration

The use of cold in the storage of food has always been familiar to the inhabitants of Arctic regions. They keep their meat for long periods in perfect condition by placing it in natural cold storage. So long as it is out of reach of wolves, sledge-dogs, and bears, the meat remains safe all through the winter. The reason for this is simply that although cold does not necessarily kill micro-organisms, yet it causes them to stop increasing in numbers, and thus limits their attack on foodstuffs.

Cold reduces the rate of growth of bacteria, etc., in two ways. In the first place, all chemical changes, and hence life processes, are slowed down by lowering the temperature. In the second place, as soon as the temperature is low enough for ice to form the amount of water in the food automatically decreases as more and more ice separates out. This is merely a particular method of drying, and so decreases the growth of micro-organisms.

Thus lowering the temperature causes a rapid diminution in the rate of growth of moulds, bacteria, etc., until finally a temperature is reached at which the micro-organisms cannot cause spoilage. The exact temperature at which this happens is not yet known. However, there is no doubt that it is lower than is popularly supposed.

Insect Pests

Insects are another cause of food spoilage. They are responsible in two ways. Many of them lay their eggs in various foodstuffs, which are destroyed by the larvæ when they emerge from the eggs. A well-known case of this is the deposition of the eggs of the blowfly in meat. The eggs develop into maggots, with disastrous results.

Moreover, all insects which come into contact with food introduce bacteria and other micro-organisms. This is readily seen by allowing an insect to walk across a plate of culture medium. Wherever its feet have touched colonies of micro-organisms rapidly develop, and an extraordinarily good record is left of its track. In the same way larger animals, such as mice and rats, apart from causing any other damage, assist in the spoilage of food by contaminating it with micro-organisms.

Chemical Changes

Another type of food spoilage is due to chemical changes. Thus, in spite of all precautions, fats are oxidised and become rancid. Even when fats are kept at low temperatures, this change occurs at a perceptible rate. For example, it was found that frozen cod-livers actually softened when kept at a temperature of 14° F., the livers being considerably changed in six months.

The case of the spoilage of grain by germination also comes into this category, as it is due to chemical changes which occur at ordinary temperatures if the moisture content exceeds a certain critical value and the concentration of oxygen is sufficient.

Fruit Spoilage

Some foodstuffs (*e.g.*, fruits) are still in the living condition during storage. This means that they respire—that is to say, they require oxygen and give off carbon dioxide. One method of increasing the storage life of such living material is to increase the concentration of carbon dioxide in the atmosphere of the store. This leads to a slowing-down of vital processes, with the result that the life of the fruit, etc., is prolonged. On the other hand, if the concentration of the carbon dioxide is increased above a certain limit, suffocation occurs and the tissues are killed. Spoilage due to this cause has occurred on a large scale in the past with apples, which suffer from "brown-heart" under such circumstances.

A type of spoilage, previously unsuspected, and due to chemical changes, has recently been discovered. In all living tissues a complicated series of chemical reactions is continuously occurring. In normal, healthy life there is a delicate balance between all these chemical changes. This balance is upset by changes in temperature because the rates of all the chemical reactions are not equally affected. Thus in the case of certain kinds of apples, storage at 34° F. is sufficient to cause a derangement of the normal chemical changes of such magnitude that the tissues are killed. This disease is known as Internal Breakdown, and its effects are well illustrated by the photograph.

Contamination by Vapours

It is obvious that foreign matters of any kind—liquids, solids, or vapours—may produce spoilage. One interesting case of the harmful effect of vapours was the contamination of a large consignment of eggs by the vapours from oranges which had been carelessly left in the same cold-storage chamber during a shipping strike. Any foodstuff containing fats is liable to contamination by vapours; for example, frozen pork has also been spoiled by absorbing vapours from oranges, and butter and milk are well known to be liable to be impregnated by objectionable vapours.

Fruit and Eggs in Cold Storage

Although cold storage is the panacea for most of the evils of food spoilage, in a few cases cold may be responsible for losses. Fruit and other foodstuffs, the tissues of which are still alive, are killed if actually

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Jam Manufacture

By HERBERT MANSFIELD, B.Sc., F.I.C., F.C.S.
Late Factory Manager for Messrs. John Moir and Co., Ltd.

PART I

A series of articles outlining some of the problems which present themselves to the Jam Manufacturer, and suggesting ways of overcoming these difficulties.

WHEN THE fruit arrives, the Management has to decide if it is to be converted directly into jam (the Direct Process) or to be preserved for jam-making at a subsequent date (the Indirect Process).

In deciding this very important point the following considerations have to be taken into account. There is no doubt that the Direct Process produces a jam richer in flavour and, owing to the fruit being less broken, better in appearance than the Indirect Process. Moreover, owing to the undoubted partial decomposition of the fruit-pectin by any of the methods of artificial preservation, the yield of jam obtained from a given weight of fruit is greater in the case of the Direct Process. Thus the *best* jam is obtained directly from the fruit, and the quicker the conversion into jam the better the result. A factory situated near a fruit-growing district has, therefore, a great advantage over one to which all fruit has to be transported by rail. Unfortunately, the manufacturer cannot consider quality alone; other points come up for consideration, the most important of which are discussed below.

Sugar Prices

It must be borne in mind that new season sugar generally arrives in early October, and therefore during July, August, and September—viz., the fruit season—the world supply of sugar is at its lowest ebb, and prices are nearly always higher than later in the year. Now if the price of sugar in July is, say, 18s. per cwt., and if it falls 3s. during the later months of the year, the manufacturer who has bought his year's supply of sugar at July prices and converted it into jam in the fruit season, will find it almost impossible to compete in price with a competitor who has pulped his fruit and buys sugar as and when he needs it to meet his monthly jam sales. Moreover, to most firms the financing of these heavy sugar purchases is in itself a matter of great difficulty.

Seasonal versus Continuous System

The next consideration is the uneconomic running of a factory if it is working during the fruit season only, which is about four months (or if marmalade is also made, six months) out of the year. Most of the highly skilled, and therefore better-paid staff, have to be kept on in comparative idleness during the remaining months, and the factory and plant have to be increased enormously in order to cope with the spasmodic periods of manufacture, thereby entailing a very much larger capital outlay than when the same amount of work is spread over the whole year.

Forecasting Packings

Another practical difficulty is that it is generally impossible to forecast the relative quantities of the particular packings which will be required. Some seasons a manufacturer will sell mostly a 1 lb. pack; next year it may be that he has a run on 2 lb. or 7 lb. packs, and so on, depending very largely on how his prices compare with those of his competitors. If his estimates have been wrong, he will be sold out of the season's popular line and have too heavy stocks of another size jar. Further, however well boiled the jam may be, and however carefully stored, there is always a slight deterioration and an appreciable loss due to crystallisation, mould, or fermentation. Thus economic necessity compels the competitive manufacturer to preserve a considerable portion of his fruit. There are three methods by which this can be done.

Chemical Preservatives

Benzoic acid and salicylic acid are still being used on the Continent for preserving purposes, but as they remain to a very large extent in the finished jam, they are not permitted in this country. Moreover, since they are only sparingly soluble in water the only practical way of using them is in the form of their sodium salts, in which case the base neutralises some of the fruit acids, and so spoils the flavour of the resulting jam. Care should therefore be taken in buying fruit pulps, especially from abroad, that these preservatives are not present. Such pulps should never be bought in large quantities without chemical analysis.

The other, and by far the most efficient preservative in general use, is sulphurous acid. This is conveniently used in form of a solution of the gas, and its amount should not exceed 5 grains per gallon of the finished pulp. It will be found that, provided the fruit is fresh, this quantity is quite sufficient to keep the pulp a year or so. The pulp should not be disturbed, but if it is to be transported as, for instance, by rail, then before consigning, an additional 2 or 3 grains should be made. Sulphurous acid has an advantage in being completely volatile, and so when the jam is boiled it volatilises in the steam. The author has tested many jams made from fruit preserved in this way, and has found that only the merest traces remained in the jam; the amount was always well within the limit of 0·3 grains per lb. allowed by the Minister of Health. This method of preservation should always be adopted in the case of strawberries and raspberries, whose delicate structure does not lend itself to pulping by boiling. Sulphurous acid

can also be used for gooseberries, greengages, apples, and plums, but in these cases it must be pointed out that it has a marked deleterious action on the pectin of the fruit and, therefore, an adverse effect on the setting power of the jam, and should be used only when it is not possible to pulp the fruit by boiling.

As above explained, the use of sulphurous acid is the only practical way of preserving strawberries and raspberries, but since these particular fruits have a very low pectin content, the adverse action on the setting power is not very pronounced. In the case of plums, gooseberries, currants, and apples, however, this action is of such an order that the use of the preservative is only justified in cases of necessity, as, for instance, when the fruit is arriving more rapidly than the pulping plant can deal with it.

Pulping by Heat

The actual pulping process can be carried out most readily in a large wooden vat. It should have steam coils fitted with a wide-mouthed rim kept well away from the bottom of the vat, and so arranged that the whole can be easily cleansed. Alternately, the pulping can be done in the actual jam-pans. In either case the fruit is mixed with about half its weight of water and boiled till soft, which, with steam at about 30 lbs., usually takes 10 minutes. By this time most of the added water will have boiled off, and the chemical composition of the pulp will not differ very greatly from that of the fruit used. The hot pulp is run straight into thoroughly cleansed 40-gallon casks, which should not be used for another kind of fruit. If the casks are filled while the pulp is near boiling point no preservative of any kind is necessary, but a pint of sulphurous acid should be added if the bung has to be removed or if the pulp has to be transported by rail.

The older method of storing pulps in stone bottles of 2 or 3 gallons capacity is seldom used now, partly owing to the initial cost of the vessels and partly to the labour of handling, but there is little doubt that better-flavoured products can be obtained from pulps which have been stored in this way; particularly is this noticeable in the case of black currants and damsons. The author has found that in using bottles, the addition of a trace of sulphurous acid is desirable, because it is seldom possible to fill and cork the bottles in such a way as to prevent the growth of mould on the pulp, and this would, of course, spoil the flavour of the resulting jam.

The only remaining containers that need be considered are cans made of either plain or lacquered tin-plate. Practically all imported pulps come into the country in cans, and only in the case of the more acid fruits such as black currants are lacquered cans used. The tin protects the iron for months, and it is only after long storage that serious corrosion takes place, but if the can is lacquered the pulp will keep for years. The same can may be used over and over again if the plate is thick and the lacquer good. This method is very convenient, because the tins can be stored very compactly and can be used a few at a time as desired, but it necessitates a considerable amount of work for the tinsmith, who is a highly paid hand.

Of the above methods, undoubtedly the wooden casks are the cheapest and most generally adopted method of storing pulp.

Parboiling

A third method of preserving fruit is by the use of sugar, and is known as parboiling. About half the sugar required for jam-making proper is mixed with the fruit in a steam pan and boiled for a few minutes. The mixture of sugar and fruit is then transferred to wide-mouthed jars, or to wooden casks, in which the sugary pulp is kept till it is needed for jam-making. This method is costly in that the containers cannot in practice be completely emptied, and therefore there is a considerable loss of sugar; also, the cost of steaming is heavy. On the other hand, the flavour of the jam is excellent, and it can be described as made from fresh fruit. The difficulty of the size of the jars which will be needed to meet trade requirements is also overcome, and only half the season's sugar is immediately required.

Refrigeration

Attempts have been made to preserve fruit in its natural form, the most obvious one being the method used for preserving meat—viz., freezing. Ultimately this may be successful, but in the author's experience the expense of refrigeration is too high to make it practicable. Moreover, the colour and texture of the fruit change in some cases, as, for instance, in frozen greengages; the skins become very hard and darken to such an extent that the fruit could not be used for greengage jam. Black currants and loganberries, however, give excellent results, and if the fruit had to be kept a short time only, freezing might be resorted to; but as it is often necessary to store for several months, unless the cost of refrigeration can be reduced, it does not seem feasible to preserve large quantities of fruit in this way.

Experiments have also been made in preserving apples, etc., in an atmosphere of carbon dioxide, but again, they have not yet led to any results which assist the manufacturer.

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frozen. After such treatment fruit can only be used for such processes as jam-making, and even this is not feasible with all fruits, because some of them become discoloured as soon as they are thawed.

Eggs are another case in which irreversible changes occur on freezing. The storage temperature must never be allowed to go below 21° F., otherwise on thawing the yolk is found to have become a putty-like mass.

Further Research Needed

The general causes of food spoilage have thus been worked out by scientists, but there is urgent need for further research in the application of scientific principles to the problems presented by many particular foodstuffs. The results of such investigations of food spoilage are of especial importance to island communities, such as Great Britain, which are, to a large extent, dependent upon a continuous supply of imported foodstuffs.

Testing Pulps

From the above it will be seen that the jam manufacturer has generally to preserve his fruit in the form of pulp, and he gets into the way of regarding pulp as his raw material, and often, as the season advances, he finds he has to replenish his stock of a particular pulp by purchasing some which has been "put down" by an unknown maker. If a chemist is employed, all pulps should be submitted to him for analysis before purchase, as it may well be that they contain far more water than they should. Failing chemical analysis, an experimental boil of jam should be made to test the yield of jam obtainable. Tables are appended showing the results of the author's analyses of various fruits and fruit parts drawn from different sources. In the case of the analyses of the pulps only those of good average quality have been tabulated.

TABLE A.

ANALYSES OF FRESH FRUITS.

Fruit.	Total Solid Matter.	Dissolved Solid Matter.	Acid (as Citric).	Pectin.	Sugars.	
					Reducing.	Cane.
APPLES:						
Green	9·41	7·35	1·10	0·75	4·03	Nil
Codling	15·0	10·9	1·44	0·77	5·81	2·14
Tasmanian ..	12·0	8·7	1·40	0·61	5·32	0·23
Wellingtons ..	14·2	13·18	1·00	1·00	8·85	2·0
BLACK CURRANTS:						
English	17·6	16·6	2·34	0·86	4·95	Nil
French	17·2	11·45	1·59	0·94	6·94	Nil
RED CURRANTS:						
English	17·9	9·08	2·26	0·47	5·65	Nil
GREENGAGES ..	13·28	10·26	1·37	1·07	4·46	0·64
DAMSONS	13·41	12·81	2·01	1·62	4·63	2·03
PLUMS:						
Very green ..	9·78	8·74	1·83	1·08	2·78	0·92
Victoria	9·4	8·16	1·51	1·10	3·79	0·49
STRAWBERRIES:						
Wisbech ..	10·33	8·34	0·99	0·41	4·52	Nil
From same field later in season	11·0	8·8	0·75	0·45	6·41	Nil
RASPBERRIES:						
Wisbech ..	15·1	6·25	1·40	0·27	1·81	Nil
Kent	13·3	6·43	1·57	0·34	2·68	0·32
ORANGES:						
Seville (peel was 36·5 per cent. and was rejected) ..	15·73	10·33	4·06	1·20	2·70	0·8
Malaga (peel 35·8 per cent.)	17·8	10·3	3·7	1·18	2·60	0·67

TABLE B.

ANALYSES OF AVERAGE COMMERCIAL FRUIT PULPS.

Fruit.	Total Solid Matter.	Acid.	Fruit Reducing Sugar.	Cane.	Water
APRICOT:					
Italian	12·6	1·28	6·2	0·2	87·4
Californian	14·5	1·05	6·6	0·7	85·5
Spanish	13·0	1·5	6·0	2·1	87·0
BLACK CURRANT:					
English	13·0	1·40	3·01	Nil	87·0
English	16·0	2·12	4·10	Nil	84·0
French	17·6	2·34	4·95	Nil	82·4
RED CURRANT:					
Dutch	10·7	1·47	2·22	Nil	89·3
English	11·9	1·49	3·80	Nil	88·1
GOOSEBERRY:					
Dutch	7·7	2·05	2·27	Nil	92·3
English	8·9	2·2	3·46	Nil	91·1
GREENGAGE:					
Spanish	13·5	0·68	6·11	Nil	86·5
English	16·7	0·82	9·61	Nil	83·3
English	10·5	1·11	4·4	Nil	89·5
PLUM:					
English	11·0	1·74	6·06	Nil	89·0
English	10·8	1·70	6·48	Nil	89·2
Argentine	10·2	1·51	5·48	Nil	89·8
Czecho-Slovakian ..	10·0	1·04	6·15	Nil	90·0
Dutch (10 per cent. added water)	4·5	0·62	0·22	Nil	95·5
Parboiled Pulp	48·6	0·97	42·8	3·3	51·4
RASPBERRY:					
English	10·7	1·25	3·48	Nil	89·3
Dutch	13·0	1·51	3·78	Nil	87·0
Tasmanian	14·1	2·07	4·23	Nil	85·9
STRAWBERRY:					
English (Evesham) ..	11·7	0·94	5·9	1·0	88·3
Wisbech	10·9	0·98	4·78	0·92	89·1

The "Bass" Patent Cask Washer.—This is the title of a booklet dealing with the washing of casks used in breweries and other establishments. It points out the fact that cask-washing at the brewery, for example, presents an admirable field for the adoption of time and labour saving methods, and gives an account of a system which has proved remarkably successful. This system involves an installation comprising one or more "Bass" Patent Cask Washers with certain accessories, a "Plurovane" high lift turbine pump, and a rotary air-compressor and air-receiver.—Mather and Platt, Ltd., Manchester and London.

On the Paucity of Technical Periodicals dealing with Cocoa, Chocolate and Confectionery

By A. W. KNAPP, B.Sc., F.I.C.
Chief Chemist, Cadbury Bros., Ltd.

THERE IS no doubt about the need for a sound technical publication dealing with food manufacture. While certain sections, for example, brewing, dairying, etc., seem to be fairly well catered for, others have long been neglected. In the chocolate and confectionery section, for example, the present trade periodicals deal with the purely retailing aspects of the industry, but they deal comparatively little with the scientific and technical facts which are the basis of manufacturing operations.

For the years 1913-1914 there appeared an excellent publication called *Products and Machinery*, which contained up-to-date statistical and technical articles, mainly by Continental experts, on various food products and the machinery required to produce them. This periodical was greatly appreciated at the time of its publication, and since the war killed it, the technical man in the chocolate and confectionery factory has been without a journal. He has had to depend on the rare, but excellent, publications which are issued privately by the Cocoa and Chocolate Research Association, and certain American publications. These latter, though foreign in their methods of appeal, nevertheless are of considerable interest, because, amidst the typically American chats on business efficiency, are to be found sound articles written by people who are *au fait* with the technical problem of the industry. In the great bulk of English periodical literature it is rare to find anything referring to our special subject. From time to time the alert eye of Mr. Hamel Smith finds matter for comment on cocoa and chocolate, and he discourses thereon in his monthly article on the Cocoa Market in *Tropical Life*. He deals, however, mainly with problems of supply and demand, having a good knowledge of tropical conditions and the planters' needs, but he does not pretend to knowledge of manufacturers' methods or recipes. On the other hand, the German publication, the *Gordian*, which is noted for the completeness and accuracy of its cocoa statistics, contains trenchant articles from the pen of its able, energetic, and dogmatic editor, Herr Reick, in which he freely castigates the manufacturers on the errors of their methods.

This rapid bird's eye view practically covers the periodic literature on cocoa, chocolate, and confectionery which is available in England, and emphasises the need for the present publication. The appearance of such a journal is a recognition of the fact that these industries, whilst still arts, are gradually, as production is in greater and greater units, being subjected more and more to scientific and technical control. In further recognition of the fact that food manufacture is now a science, it is of interest to note that the Institute of Chemistry has just included *food manufacture* as one of the branches in which a chemist may take the examination for the fellowship.

"Death on the Doorstep"—As seen by our American cousins.

The Raw Material of the Bacon-Curing Industry

By F. W. JACKSON, B.Sc., A.C.G.I., A.I.C.,
Chief Chemist, Marsh and Baxter, Ltd.

PART I

The bacon-curing industry is in a peculiar position in that the demand for raw material exceeds the supply, the price paid for pigs bears no relation to the cost of production, and the lack of uniformity in the raw material cannot be allowed for in manufacturing. These difficulties of the curer, incidental to his raw material, are briefly outlined below. The subject will be dealt with in greater detail in future issues.

MOST MANUFACTURERS of foodstuffs are able to exercise a considerable amount of choice in selecting their raw material, and, moreover, they can allow for variations in the latter by adjustments in manufacturing details in order to produce a finished article of uniform quality. In fact, judgment in buying and skill in manufacture are two important factors which help to make a success of the finished product.

So far as bacon curing is concerned, manufacturing skill is, of course, brought into play, and many are the carefully guarded secrets which surround this operation. But owing to the nature of the raw material, it is useless to modify the process in an endeavour to overcome inherent differences as between one side of bacon and another. Thus, the process is probably as uniform year after year as one can hope for, every single operation being standardised. Since variations in the finished article *do* occur, they must be traceable to variations in the raw material.

One would therefore expect that the bacon-curer would endeavour to exercise judgment in buying his pigs. But the demand for pigs far exceeds the supply, and selection in buying is almost impossible. There is a considerable number of reasons for this somewhat rare situation, and a few of them are detailed here below.

Influence of Imports on Prices

The retail bacon trade, as everybody knows, is dominated in the proportion of 2 to 1 by the imported article, which fact accordingly influences the selling price of bacon. Consequently, the price which the home-curer can offer for his raw material bears no relation to the cost of the production of pigs. Thus it happens that at one time large profits can be made from the breeding and fattening of bacon-pigs, whilst perhaps only a few months later it is hardly possible to make any profit.

A bacon-pig is usually seven months old when it is ready for the curer; accordingly, anyone starting to breed pigs *de novo* may have to wait twelve months before he sees any return for his investment. The period is long enough to witness a complete change in the prospects of breeding, with the result that farmers are very slow to take it up. On the other hand, it is possible to sell out very rapidly, a circumstance which does nothing to stabilise prices.

Short Supplies of Pigs

These circumstances, and many others, have the ultimate effect of keeping supplies of pigs very short. We have also as an illustration of this the extraordinary fact that the pig population of these islands at the present time is the same as it was at the Norman Conquest, namely about two millions. The result is that bacon factories all over the country seldom, if ever, exceed half capacity, which is bound to inflate the proportion allowed for overhead charges in the selling price of bacon. Another effect is that the bacon factory is almost forced to buy every animal it can find; thus there are few opportunities for selection so far as the raw material is concerned.

The Significant Points of a Pig

Pigs, of course, are not assessable by chemical analyses, and an animal which is suitable externally may be not at all an ideal subject when examined inside. The external characteristics are valuable in two ways, which may be called direct and indirect. So far as direct characteristics are concerned, one may note the length of the animal from shoulder to tail-root, the depth from back-bone to underline, and the shape of the hams. These points indicate to the curer such important items as the percentage of curable material, the proportion of "middle cut" (the most valuable section) to the total side, and the quality of the hams.

Indirect characteristics are points like the fineness of the hair, which is supposed to be an indication of leanness and so on. With sound experience behind him, the curer is thus able to pick out those animals which will make the best bacon.

Carcase Examination

When the animal is slaughtered one thing that becomes evident is the presence of disease, such as tuberculosis, this may be localised in nature, for instance in the glands of the throat, and when this is so, the rest of the carcase may be quite safe for food. On the other hand, the whole carcase may have to be condemned. Veterinary inspection is therefore a matter of routine in large establishments.

The carcase will also reveal the proportion of lean to fat and the probability of streakiness in the rasher; and, lastly, the texture of the fat tissues will forecast the probable presence or absence of undesirable flavours in the hams and bacon.

Inspection, therefore, shows whether the carcase is fit for curing or not, and if so, what style of bacon is to be made from it. Grading into further subdivisions varying in quality and price is also necessary after curing has been completed.

Modern Sweet Manufacture

By R. H. MORGAN, B.Sc., A.I.C.

PART I

The making of confectionery affords a striking example of what was, up to quite recently, a miscellany of so-called secret recipes and practices handed down with but little change from generation to generation. Under the stimulus of modern science it has thrown off these petrifying influences, and is rapidly developing into a vigorous industry of the very first rank.

THE SUGAR confectionery industry in recent years has, in methods and outlook, undergone a change probably greater than that ever experienced by any other industry. This ancient and conservative art, whose secrets have been most jealously guarded throughout the ages, is now rapidly developing on the basis of scientific method.

Those wonderful productions of the old sugar-boiler, the accumulated experience of generations of effort, are now realised to be sugars existing in various forms and states of matter well known to the chemist and physicist. Consequently the scientist is taking an active part in the manufacture of sweets. Chemists are actively engaged in improving and simplifying methods of manufacture, and with their specialised knowledge they are endeavouring to overcome difficulties which hitherto rendered further progress impossible.

Raw Materials

Dealing briefly with some chemical aspects of the industry, the basic raw materials used are contained in that complex carbohydrate group—the sugars. The trade term "sugar" refers to the ordinary domestic variety which chemically is known as "sucrose."

"Glucose" to the confectioner does not mean chemically pure dextrose, but it is a syrup obtained by the acid hydrolysis of starchy substances. The inversion of potato or maize starch gives a viscous liquid containing varying amounts of maltose, glucose, dextrins, and water, together with traces of proteins and other matter. Invert sugar is used in the industry to some extent, and molasses and various other less refined sugars are also employed.

For flavouring purposes a variety of substances are used, such as acids, butter, essential oils, herbal extracts, vegetable bodies, synthetic essences. The careful examination of such a wide range of materials used in the industry, together with the maintenance of a high standard of quality and purity in each case, necessitates the employment of a competent analytical chemist.

High-Boiled Sweets

Various lines of confectionery can, in a broad sense, be classified under two headings—viz., high-boiled and low-boiled sweets. Still more loosely these classes can be distinguished as "hard" sweets and "soft" sweets.

High-boiled sweets consist of sugar in a more or less vitreous form containing practically no water, with suitable colouring and flavouring matter worked in. Such a solid is obtained by boiling sugar, or a mixture of sugars, to temperatures varying between 280° and 320° F., and maintaining the sugar in a kind of artificially super-cooled condition when cold.

There is a tendency for a certain amount of invert sugar to be produced when sugar is heated to a high temperature. As invert sugar is naturally soft and hygroscopic, its formation is a disadvantage when manufacturing hard sweets. In the past it has often been a custom in the trade to add certain chemical substances to the boilings for hardening purposes. Sulphite compounds have been very popular as "hardeners," especially as the sulphur dioxide liberated by the heat of the syrup exerted a bleaching action on the sugar. Owing to a recent pronouncement by the Ministry of Health, bleaching agents must no longer be used in confectionery processes, and therefore sulphites cannot be used in future.

The alkali salts of weak acids generally act in a manner which retards inversion of sugar, and chemicals which can be experimented with for hardening purposes include acetates, phosphates, oxalates, and citrates.

Low-Boiled Sweets

In the case of low-boiled sweets the sugar or sugar mixture is rarely boiled above 270° F. When a sugar solution is boiled and cooled again without crystallisation taking place, the hardness of the resulting solid depends on the temperature to which the syrup has been raised. Caramels can be taken as one example of low-boiled sweets.

Crystallisation is a physical phenomenon which plays an important part in the confectionery industry. Fruits or confections of various kinds are often placed in saturated syrups to act as nuclei for crystal formation, thereby becoming covered with crystals or "crystallised." Usually small crystals are required, but in the case of sugar "candy" slow cooling produces the necessary large crystals.

Fondants and creams consist of minute sugar crystals, kept moist by a surrounding film of mother liquor. They are usually coated with chocolate or crystallised to prevent them becoming dry and hard.

An interesting example of enzyme action has now been introduced into the preparation of creams for soft-centred goods. A small proportion of invertase is mixed with the cream before coating, and in a short time it inverts a considerable amount of the sugar crystals, thus increasing the softness of the centre. In this type of low-boiled sweet inversion is

encouraged, which is exactly opposite to the requirements of high-boiled goods.

Science and Confectionery

The manner in which confectionery is packed and the types of container used also come in the province of chemical science. This involves a close study of all possible climatic effects on the goods themselves. Particularly is this important in the case of goods prepared for export. Both in the manufacture and in the packing variations often must be made to enable the sweets to stand up to foreign climatic conditions, so different from those in the home country.

An essentially important point in an industry manufacturing foodstuffs is the maintenance of absolute purity in all its products and strict compliance with all food laws. Modern sweet-making has to be carried out in well-ventilated and hygienic factories, and from the initial raw materials to the confectionery in its finished state no deviation from the highest standard of purity can be allowed.

Although confectionery was popular with the ancient Egyptians, and empirical methods have survived through countless ages, it is still young from the point of view of scientific method. There are many phases of works processes yet to be explained, and the research chemist has an abundance of problems requiring solution. Still there can be no limit to the development of the industry now the principles of chemistry are being applied to all its branches. This co-operation between chemist and confectioner will be to the advantage of the manufacturer and a safeguard to the consuming public.

A Matter of Definition

By F. E. THOMAS, M.A.

AT THE present time we have, as we always have had and always shall, our food cranks—our vegetarians, our big meat eaters, the one-meal-a-day type, the wholemeal-bread fanatic, the anti-sweet brigade, the banana-and-uncooked-food coterie, and so on. The great trouble is that all these sects are convinced that they are supported by scientific facts which lead to only one conclusion—the one that they, separately and individually, have adopted. It is very clear that science, like religion, has got a good distance to go yet before the ultimate truth is discovered, and we may well ask what is to be the future function of science in food manufacture.

Undoubtedly one of the tasks which confront scientific men and the trade is the question of definition of common foodstuffs. The responsibility for the settlement of this matter lies with science, because science is responsible for the multiplicity of preparations added to foodstuffs either because of their nutritive value or because they achieve some desirable result, and the nature of many common foodstuffs has been altered appreciably from the simple preparations of our forefathers. The need for definition finds further support in the consideration that, until such definitions exist, the food manufacturer lends himself open to the insidious charge of food-faking, a notable example of which occurred recently in a series of articles in the columns of a Northern daily paper. Many of these charges boiled down to the statement that manufacturers were making cheap varieties of their goods by the admixture of cheaper foods—not a matter of faking at all—but the dividing line between the two is a difficult one to fix in the absence of exact description of many foods. It is so extremely easy to start a scare on this subject that all common edibles should be, like Cæsar's wife, above suspicion, and their nature so well known that it is possible to say quickly whether they are or are not what the law requires.

The chemist and the manufacturer in combination have many other problems to solve in the future, but it is a matter for congratulation that so much has been achieved already. Looked at from the point of view of absolute knowledge, it must be admitted that the chemist still knows very little, and admits it; the manufacturer doesn't know a great deal, but daren't admit it; but the pleasing thing is that the two together are now working hand-in-hand to the final goal, and are giving the consumer reliable products of a wholesome nature to a far greater extent than hitherto, and that in spite of the increasing difficulties due to larger populations, changes in the public taste, and in the standard demanded of them.

Finally, one of the tasks of definition which those in the trade should settle as soon as possible is—what is really meant by "pure" food? This is easily the most abused of all ordinary adjectives used at the present time in connection with food. Does it mean "clean" food? If so, there is no manufacturer of repute who is not supplying pure food. Does it mean "food that is readily assimilable by the human system—food that produces little waste products"? It would be difficult to supply a food to the general public which would be equally efficient in its action on all individuals in this respect? According to popular interpretation it does not seem always to mean the most nutritive food, otherwise there would be a condemnation of a whole lot of very delicious and delightful foods which do not possess high nutritive qualities. In fact, everyone has his or her own idea as to what "pure" food is, and in that case, it is difficult for the manufacturer to satisfy every member of the public. This problem of definition is a very big and a very difficult one, and cannot possibly be solved for a long time to come, but it is one to which all sections of food manufacturers should give earnest and serious attention.

Bacteria and the Canning Industry

By R. F. HUNWICKE, B.Sc. (Lond.), A.I.C.,
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Micro-organisms, whether they be moulds, yeasts, or bacteria, are enemies against which the Canning Industry wages constant war. The more the manufacturer knows about their peculiarities and habits, the greater are his chances of bringing them under complete control.

THE CANNING Industry is deeply concerned with bacteriological problems, although the subject is approached from a somewhat different aspect than is the case with other industries in which micro-organisms play a part. In brewing and tanning, for example, it is the beneficent activities of micro-organisms which chiefly concern the manufacturer; he calls in bacteria to carry out his processes, and they are for the most part allies, not enemies.

In the Canning Industry, however, all micro-organisms are potential enemies of the manufacturer. They are enemies from two points of view. In the first place, there is the possibility of spoilage of vast quantities of a product, if the conditions of "processing" are for any reason inadequate to destroy some particular strain of organism with which the food has become infected. In this case the matter is purely an economic one. Secondly, the manufacturer may be faced with the possibility of infection of his product by some disease-producing organism, which, if its activities are not checked, may lead to illness, and possibly death, amongst those consuming the food.

It may be said at once that the first problem is by far the commoner; food poisoning as a result of the consumption of canned goods is comparatively rare, and the prejudice which some members of the public still seem to feel against such foods is mostly due to imperfect acquaintance with a subject which is after all highly technical.

This article will therefore be concerned chiefly with the subject of the commercial spoilage of canned foods, and its causes.

The problems connected with canned meat and fish are fundamentally different from those connected with condensed milk and canned fruit and vegetables, and will be treated separately.

The Classification of Bacteria

Before proceeding to the consideration of the bacteriology of canned meat and fish in detail, it may be well briefly to refer to the different types of bacteria and to explain the classification which, for purposes such as the present, is the most convenient to adopt. It should be noted that the following classification is not a botanical one such as has been officially adopted by the Society of American Bacteriologists; from a purely scientific point of view it leaves much to be desired, but it is undoubtedly convenient for practical purposes.

Micro-organisms may be divided into three main groups:

I. The moulds. II. The yeasts. III. The bacteria.

The first two groups are of great importance in connection with condensed milk and canned fruit, but not in connection with canned meat and fish. Members of Group III, the bacteria, are found in all classes of canned goods.

Bacteria are single vegetable cells which multiply by single division of the individual. The group may be divided into two sub-groups:

(*a*) bacilli, or rod forms; (*b*) micrococci, or spherical forms.

The bacilli are further divisible into two important classes:

(i) sporing bacilli; (ii) non-sporing bacilli.

A spore is, to some extent, though not in the strict botanical sense, analogous to the seed of the higher plants. A sporing bacillus has the ability to produce within the cell a small body possessing great resistance to heat and antiseptics. This spore will remain intact when the whole of the vegetable cell has perished, and should the spore fall on to favourable soil it will grow out from itself a new vegetable cell, which will then begin to multiply by division, the new bacilli thus formed reaching the sporing stage in their turn. It is evident that the destruction of sporing bacilli by heat is more difficult than is the destruction of non-sporing bacilli; indeed, spores are known which have resisted boiling for two hours, or more.

Amongst the sporing bacteria are some types which are only able to grow in the absence of oxygen. These are known as the obligate anaerobes, and some interesting facts with regard to their effect on the spoilage of canned foods will be presented later.

Many other bacteria, both cocci and bacilli, can grow in the absence of oxygen as well as in its presence. These are known as facultative anaerobes.

Canned Meat and Fish

As has been said, the influence of yeasts and moulds on the above class of canned foods is negligible, and this section will be confined to a consideration of the bacteria which are to be found in canned meats and fish, their possible effects on spoilage, and the factors which influence their activities.

At the outset it may be said that comparatively few sound samples of canned meats or canned fish and crustacea are actually sterile. Savage, Hunwicke, and Calder (Food Investigation Board, Special Report No. 11, 1922) examined seventy-six sound samples, purchased in shops in the ordinary way, and found that 62 per cent. contained living bacteria of one kind or another, though the food was perfectly sound and fit for consumption.

This common occurrence of bacteria in commercially saleable canned meats is not of importance

from the Public Health point of view at all. It is perhaps not sufficiently realised by those who are not thoroughly familiar with the subject how enormously the harmless strains preponderate over the pathogenic or disease-producing strains of bacteria. It is perfectly clear that it is unjustifiable to argue that a sample of canned meat should be condemned as unfit for food merely because it is not sterile, and any attempt to impose administrative action of that nature would rightly be resisted by the manufacturer.

The fact that living bacteria can so frequently be found in sound samples indicates that "processing" is by no means true sterilisation, though no doubt many manufacturers feel confident that, as practised by them, it is such. In the case of the seventy-six samples examined by Savage and his co-workers, sixty-four different strains of bacteria were isolated and studied, and it is significant that forty-nine of these were sporing bacilli of one kind or another. These sporing types are by far the most resistant to heat, on account of the thermo-stability of their spores, and it is probable that the attempt to destroy them in canned foods would necessitate the use of temperatures in processing which would be detrimental to the product.

Rather the concern of the manufacturer should be to attempt to exclude bacteria of all kinds by meticulous attention to cleanliness before the processing stage is reached. It cannot be sufficiently emphasised that processing is not a substitute for cleanliness.

Now assuming, as we must do, that neither cleanliness nor processing can entirely exclude bacteria from canned meats, it is of interest to see what types of bacteria are likely to cause spoilage, and what are the conditions under which spoilage will take place.

The Anaerobes

It has been said that certain sporing bacilli (the obligate anaerobes) are unable to multiply except in an atmosphere containing a minimum quantity of oxygen. It would therefore seem an obvious conclusion that if any of these bacilli or their spores survive processing, they will be more likely than any other type to multiply and cause spoilage, seeing that quite a high vacuum is induced in an air-tight tin after processing and sealing. The canner has always empirically realised the importance of a high vacuum in his tins. At first sight it would seem as if a high vacuum would, on the other hand, actually be an encouragement to obligate anaerobes to develop, but curiously enough experiments have shown that this is not the case, and that it is leakage of air into the tins which is to be feared, even when anaerobes have escaped processing. This apparent anomaly is to be explained by a consideration of the following facts.

Experiments carried out by the workers referred to above showed that the spores of anaerobes when present in small numbers in canned foods (and they frequently are present), in many cases do not develop and form vegetative cells with subsequent multiplication and ultimate spoilage by decomposition of the food. But when tins containing a few such spores are punctured, and air is allowed to enter through cotton-wool plugs, on re-sealing the tins the anaerobes develop and rapidly decompose the food, causing the tins to become "blown."

The reason for this anomaly is that the access of air favours the multiplication of aerobic organisms which may also be present, and when these are of proteolytic type—*i.e.*, are capable of breaking down proteins—they provide the necessary pabulum of decomposed protein in which the anaerobic spores can begin to develop. This conclusion was arrived at after a series of experiments which it would take too much space to describe here, but an account will be found in Report No. 11 of the Food Investigation Board, and the point is well substantiated. It is undoubtedly of considerable practical importance. In the past, minute leaks in tins have been looked upon chiefly as providing a means of entry for outside bacteria. Their importance is now shown to lie rather in their allowing the entrance of small amounts of oxygen, which, in the words of the Report, "light up and set into activity already existing but dormant bacilli."

Sporing Aerobic Bacilli

These are found in all classes of canned meat and fish products, both in sound and unsound samples. Many of them are markedly proteolytic, and are therefore a potential cause of spoilage. Yet in many cases their presence does not result in decomposition of the food. Experiments have shown that this is due to the fact that though many strains can grow to a certain extent under strict anaerobic conditions, they cannot do so to a sufficient extent to cause decomposition. Again the importance of leaks in the tins is manifest, and the immediate effect of the introduction of a little air is to enable such organisms, if present, to multiply and rapidly decompose the food.

The effect of their activities on the obligate anaerobes has been referred to above.

Non-Sporing Aerobic Bacilli

This group is divisible into several sub-groups, some of which are proteolytic—*e.g.*, the Proteus type—others being fermenters of the sugars but non-proteolytic—*e.g.*, the B. coli type. Practically all these organisms can grow equally well either aerobically or anaerobically. Organisms of the Proteus type are very frequently the cause of spoilage, causing "blowing" of the tins and decomposition of the contents. The B. coli type of organism, while it is often associated with "blown" tins, does not as a rule cause any noticeable decomposition. This is to be expected since this type of organism is non-proteolytic. These non-sporing bacilli are very seldom found in sound samples. When spoilage of a can is traced to this cause it argues very imperfect processing, since non-sporing bacilli are very readily destroyed by heat. *Micrococci* are of practically no significance as regards spoilage. Some types are rather resistant to heat, and this may account for their presence in tins which are perfectly sealed. In other cases they may gain access through minute perforations.

It will be noticed that nothing has been said as to food-poisoning types of bacteria, such as the Salmonella group. This is really a subject in itself, and deserves separate treatment. Happily such organisms are very rarely found in canned foods.

Condensed milks and canned fruits will be dealt with in a subsequent article.

The Estimation of Preservatives in Foodstuffs

By H. DRAKE-LAW, D.Sc., F.I.C.

No really satisfactory method of estimating accurately the sulphur dioxide content of foodstuffs has been devised. Below, the commonly used methods are critically examined and are found to give unreliable and inaccurate results. An entirely new and specific method of estimating the preservative is urgently required; and, above all, a standard and official method. This will at least help to obviate unjust prosecutions under the new Public Health Regulations.

THE LIMITATION of preservative now prescribed by the new Public Health Regulations calls for a degree of analytical accuracy which has hitherto been unnecessary, and many authorities have critically tested the various published methods of estimating the minute traces of extraneous matter involved. The greatest attention has been turned to the use of sulphur dioxide, as this product is widely employed for preserving purposes. Its presence has furthermore been discovered in certain essential raw materials in quantities far exceeding those hitherto suspected, and in greater amount than is now permissible. The evidence of copious research has shown that widely divergent results may be obtained by a slight modification of the testing procedure. It is advisable, therefore, briefly to review the various methods that have been proposed for the estimation of small quantities of sulphur dioxide in foodstuffs.

Two main classes of procedure have been described. (1) Sulphur dioxide is reduced with zinc to sulphuretted hydrogen and estimated as lead sulphate; (2) sulphur dioxide is oxidised to sulphur trioxide and finally weighed as sulphate.

(1) The reduction method was introduced about 20 years ago, and was intended primarily for the testing of sugars. The procedure is briefly as follows: The sucrose solution is acidified with sulphuric acid and reduced with granulated zinc. The gases liberated are passed through a lead acetate paper, and the sulphuretted hydrogen is estimated by the intensity of the stain. The apparatus used is similar to that employed for the estimating of arsenic by the Gutzeit test. The detailed procedure has been described in a recent issue of the *International Sugar Journal*. The above method is very simple and expeditious. Results may be obtained rapidly and several estimations can be carried out concurrently. The great disadvantage of the test is that it is not specific for sulphur dioxide, and many other sulphur-containing compounds react in a similar manner. Its application has hitherto been confined to the sugar and glucose industries, but the procedure should find a more extensive use if only as an eliminating test.

(2) The second method, or some modification of it, is that generally employed by analysts, and it has therefore been subjected to the greatest amount of investigation. The material to be analysed is diluted with water and acidulated with phosphoric acid. The mixture is then distilled in an atmosphere of carbon dioxide, and the distillate containing the sulphur dioxide is collected and estimated by one of several methods. It may be titrated with iodine solution or oxidised to sulphur trioxide. The latter may then be quantitatively determined by precipitation with barium sulphate or by titration with standard alkali. The best known oxidising agents that have been proposed are iodine, bromine, and hydrogen peroxide. The chief drawback to the oxidation procedure is that the reactions involved are not limited to sulphur dioxide. Other compounds may and do respond to a similar treatment, and no modification has as yet been proposed which can be relied upon to give the degree of accuracy now required.

Many recent investigations have been carried out to determine the relative accuracy of the various methods proposed. Certain fundamental difficulties have been encountered however. Sulphur dioxide reacts rapidly with many of the products with which it comes into contact, and causes an immediate loss of preservative. This is partly due to oxidation, but also to direct combination with the food material. The missing proportion of sulphur dioxide may or may not reappear under the action of the reagents used for its estimation. Certain foodstuffs show the presence of sulphur dioxide when none has actually been added. Others which originally gave no test for sulphur dioxide will, on standing, show appreciable amounts. It is therefore almost impossible to find a satisfactory method for estimating the small traces of sulphur dioxide which are now permitted in foodstuffs.

Other sources of inaccuracy also occur. A portion of the sulphur dioxide is generally oxidised during manipulation, the amount of the loss being proportionate to the duration of the distillation. This source of error may be partially avoided by increasing the speed of the operation, but it can never be entirely eliminated. There is also a certain amount of entrainment during the distillation, and sulphates are frequently carried over bodily in this manner, producing inaccurate results. Another difficulty is encountered when using glass receivers. Glassware frequently contains considerable quantities of sodium sulphate, which is readily extracted with water, and is an obvious source of error.

We have made a series of tests on various types of foodstuffs which have been brought to our notice, and some of the results are given below.

Caramel (cane sugar)

This product is not mentioned in the new schedule of foodstuffs, and it may be assumed that the permissible amount of sulphur dioxide is the same as for the parent material—namely, sucrose or glucose. The estimation was carried out by distillation of the aqueous solution acidulated with phosphoric acid. The distillate was titrated with $\frac{N}{100}$ iodine, and was

also precipitated as barium sulphate. The iodine test showed 140 parts of sulphur dioxide per million. The sulphate test showed none, which was the correct result. A glucose caramel similarly tested gave 100 parts of sulphur dioxide by direct titration and 10 parts by precipitation as barium sulphate. The higher reading with iodine titration was due to the presence of volatile aldehydes and ketonic acids. The distillate was acidic in character and could not therefore be estimated by alkali titration.

Cane Sugar (Mauritius white crystal)

Tests were carried out both by the reduction and the oxidation processes. The distillate in the latter case was estimated by iodine titration and also by precipitation as sulphate. The reduction figure and the sulphate precipitation agreed, showing 100 parts of sulphur dioxide per million. The iodine titration gave a ten per cent. higher value. Similar tests were carried out with glucose and invert sugar, and in each case the various modifications of the method employed gave results agreeing to approximately ten per cent. It may be assumed, therefore, that comparative accuracy had been attained in these cases.

Starches

Much attention has recently been drawn to the analysis of edible starches, particularly cornflours. The final food regulations make no allowance for sulphur dioxide in this product, although it is invariably present in American flour and generally in the Continental product. The best British brands are free from sulphur dioxide, and we particularly wish to emphasise this fact. An American flour tested by distillation and iodine titration showed 150 parts of sulphur dioxide per million. The same flour gave only 120 parts by oxidation with iodine or bromine followed by precipitation with barium chloride. The hydrogen peroxide method and subsequent alkali titration showed only 100 parts per million. The end reaction of the latter operation is ill defined and absolute accuracy is uncertain. Other oxidising materials were also tried, such as percarbonates and perborates, but the results coincided with one or other of those recorded above.

Similar tests were conducted with Dutch cornflour. The iodine titration showed 50 parts of sulphur dioxide per million, whereas bromine and iodine oxidation gave only 30 parts. A British flour was also examined, and showed no sulphur dioxide by the sulphate method, but 12 parts by the iodine titration.

It is obvious from the above tests that iodine titration cannot be relied upon, as the results are almost invariably too high. The sulphate test is fairly accurate in the absence of other oxidisable sulphur products. The hydrogen peroxide method gives the lowest results, but it is questionable whether this procedure is any more reliable than the others. Results of an even more widely divergent nature were obtained in other cases.

Further irregularities have also been recorded in connection with the analysis of cornflour. A British product was obtained free from sulphur dioxide as tested by the bromine method. It was again tested after four weeks' standing, when it showed 25 parts of sulphur dioxide per million. The exact reason for this increase is not known, but similar results are recorded by many other observers.

Cooked Meats

An attempt was made to obtain a standard of accuracy in the case of cooked meats. Weighed quantities of sulphur dioxide were added, and the mixture was then estimated by one of the methods given above. There was invariably an immediate loss of sulphur dioxide, amounting in some cases to many hundred parts per million. The destruction of sulphur dioxide continued for several days with gradually diminishing speed, but it never became absolutely stationery. It was obviously impossible therefore to standardise the test. The analytical figures obtained, however, were similar to those already recorded.

Dried Fruits

Experiments were carried out with dried fruits, and the results very closely resembled those for cooked meats in that the sulphur dioxide which could be estimated was a gradually diminishing quantity. Another difficulty encountered in this case was caused by the massive bulk of the vegetable fibre which greatly retarded the speed at which sulphur dioxide could be distilled. The fibrous matter, even on being thoroughly minced, still tenaciously held a portion of the sulphur dioxide. The disintegration of the fibre was assisted in some cases by means of dilute caustic soda. The amount of determined sulphur dioxide was then enormously increased. It was afterwards found that the caustic soda itself contained an appreciable quantity of sulphur dioxide, but even after making due allowance for this the preservative present was in excess of the amount expected, and we believe that some decomposition of the pulp had taken place.

Conclusions

The final evidence of these and other investigations points to the conclusion that it is rarely possible to estimate sulphur dioxide with a degree of accuracy within 50 parts per million, and frequently a greater margin is necessary. An entirely new and specific method of estimating this preservative is urgently required. It is obvious that any food manufacturer's products may be suspected of containing sulphur dioxide when none has been added. We need above all a standard and official method of analysis which will give at least equal results in the hands of all analysts, and which will be of assistance in preventing unjust prosecutions from taking place.

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"Industrial Friendship"

By SYDNEY W. PASCALL, J.P.

I UNDERSTAND that this new venture in the realms of trade journalism is to deal with the manufacture of, and other matters connected with, many of the articles which constitute the daily diet of our people. There is, I'm sure, a field for much useful work in this direction; and, as one closely associated with the making and marketing of certain edibles that we contend have a genuine food value, I have pleasure in wishing every success to the enterprise.

In response to an Editorial invitation to contribute something to the first issue of this journal, I will not presume to touch upon any expert or technical features of food manufacture, but I may perhaps be permitted to offer a few observations on the industrial situation as I see it, with a few suggestions as to the lines along which the only permanent solutions can be found to the difficulties which have confronted us for some time, and which face us to-day. It seems to me that our main hope lies in the cultivation of a broad outlook, the right "attitude of mind," and the concerted action amongst all of us who are engaged in industry. There has recently been published a book which every employer and every worker ought to read, *The Secret of High Wages*, by two engineers. It shows that they have made some progress along these lines in America. I am not one of those who assume that because a thing hails from America it must therefore of necessity be superficial and insincere. There are great lessons to be learned from America, and there is one here.

Naturally and properly, the principal object of the wage earner and Trade Unions has been to secure higher wages: equally naturally and equally properly the chief desire of the employer has been to secure a working profit, or to put it in another way, to achieve less costly production. Surely one object lesson we may learn as a result of recent events is that neither party to production can secure its aim without the co-operation of the other. Supposing we exchange rôles? Let the wage earner and Trade Unionist seek to reduce the cost of production as a means, and the only means, of achieving higher real wages. Let the employer aim at paying higher wages as the only permanent method of obtaining a reduced cost of production.

I do not believe these are paradoxes. I believe they can be obtained by the co-operative effort of employers and employed. I firmly believe that if the men of goodwill among the employers and those among the Trade Union leaders were to get together on the basis of reduced cost of production plus higher wages, we should have an aim that is perfectly within our reach and an aim that by study and hard work would enable us to make a real contribution towards the industrial prosperity of our country.

I am confident that if the best minds in all classes and from all sides engaged in industry combined, they could produce a British policy that would be better suited to our national character than anything imported. This has been already done with some success in the shipbuilding industry, and this is an experiment that should be extended and emulated.

It is interesting and encouraging to have discovered that what is sometimes termed welfare work, but what is really (if it is indeed the genuine article and not the sham variety) the establishment of human relations between the various parties in industry, was in the late industrial crisis a steadying and binding influence. A seed sown years ago in the cause of human unity and personality in industry, whether it has taken the form of co-partnership, superannuation, extended sick benefit, more regular conditions of employment, or many another, without any thought of a *quid pro quo* (it would not have been much good if there had been) has had a crop in friendship and unity to-day.

I have been asked by Trade Unionists if I can be sure that those of us who think like this can induce the majority of employers to take this line. I do not know. I think a great many more employers have a receptive mind on this question to-day than is commonly supposed; but of this I am certain, that while we, acting alone, may not be able to secure a way of co-operation, a way of joint action, a way of industrial friendship, yet acting in concert with a friendly body of opinion from the workers' side and reinforced by their strong support, it can enforce our policy. Separately, it will be interesting and comparatively ineffective; united, our arguments, backed by our example, will have a great moral force that nothing can withstand.

Acting together in a way that best illustrates what I mean when I have used the words "industrial friendship," it will bring about in the major part of the field of industry to-day a real industrial pact—a pact secure because it rests upon a firm faith of those who seek to render each to the other the service of friends, and to bring about a new order strongly based on a living and working industrial friendship.

Forthcoming Articles

The Composition of Baby Foods and Invalid Foods.
Scientific Control in the Chocolate Factory.
Various Methods of Freezing and Thawing Foodstuffs.
Recent Research on Pickles.
Citrus Fruit Products.
Modern Margarine Manufacture.
The Herring Industry.
The Salting of White Fish.
Bottled Fruits and Peels.
Scientific Control in the Jam Factory.
Bacon Curing.
The Use of Solid Carbon Dioxide as a Refrigerant.
Modern Methods of Drying Milk.
The Present State of our Knowledge of Vitamines.

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(*Continued from page 6.*)

Imports and Exports.

Comparing the British exports for the first quarter of 1927 with those for the first quarter of 1926, one notes increases of 17 per cent. in jams and 4 per cent. in cured fish, while cocoa preparations and confectionery show little change. Imports of bacon from Denmark increased in weight by 34·5 per cent., but owing to diminished imports from Canada and other countries, the net increase in retained imports of bacon and hams was only 4 per cent. There was a heavy reduction in imports of frozen beef from Australia and New Zealand, and an increase of nearly 32 per cent. in imports of mutton and lamb from South America. Retained imports of unrefined sugar showed a decrease of 44 per cent., and of refined sugar 21 per cent.

The exports of cocoa from the Gold Coast for the past three months were as follows: January, 28,393 tons; February, 36,787 tons; March, 29,741 tons. The exports of cocoa from Ceylon during 1926 were 66,387 cwts. As compared with the previous year, there was a decrease in shipments to the United Kingdom, but an increase to Germany; the latter rose from 874 cwts. to 1,963 cwts.

Recent Patents relating to Food Manufacture and Preserving

The following abstracts are obtained from recently published copies of the "Illustrated Official Journal" (Patents) by permission of the Controller of H.M. Stationery Office. Printed copies of full Patent Specifications accepted may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at 1s. each.

265,840. **Spray evaporators.** Nestlé and Anglo-Swiss Condensed Milk Co. June 15, 1926.

An arrangement for drying milk or other liquid by atomizing a jet of liquid by a jet of hot air or gas.

265,850. **Boxes for viewing contents.** J. Austin, Ltd., and E. L. Austin. July 1, 1926.

A tubular box having a window at each end for rock or like sweetmeat of bar form.

265,859. **Sterilizing milk and other food.** R. Kristen. July 26, 1926.

The food is contained in glass receptacles with loosely fitting lids. The receptacles are placed in a vessel having a spring-pressed air-tight lid. A small quantity of an explosive fuel—*e.g.*, alcohol—is then ignited in the vessel by an externally operated ignition device so as to burn up the oxygen in the vessel and receptacles and create a vacuum therein.

265,865. **Coffee.** O. Gewalt. August 16, 1926.

Coffee is treated in a closed compartment to remove bad smell and taste by cooling to below 0° C. for some hours.

265,889. **Meat-cutting band saws.** J. W. Vaughan. October 20, 1926.

The whole of the saw, except a short part above the table, together with the saw wheels, is enclosed in a housing with a door.

265,910. **Treating food with radiations.** K. Hoefelmayr. April 23, 1926 (not yet accepted).

Milk in concentrated form, such as condensed or dried milk, or milk in a curdled state, is subjected for a substantial period of time to the action of artificially produced ultra-violet rays whereby it is converted into a food suitable for the treatment of disease such as rachitis. Dried milk thus irradiated is stated to keep particularly well.

265,922. **Sausage machines.** M. Wommer. December 2, 1926 (not yet accepted).

265,978. **Machine for sorting fruit.** W. A. Notenboom, A. W. Notenboom, C. P. Notenboom, and K. P. Notenboom. February 10, 1927 (not yet accepted).

An apparatus for sorting by passing over or through graded apertures.

266,011. **Ice-cream containers.** F. G. Beaton. February 15, 1927 (not yet accepted).

A conical ice-cream, etc., container is provided with a cover, say of tissue paper, of truncated conical form, made by securing the edges of a blank together, the wide upper end of the cover being twisted together after the ice-cream container has been placed within it.

266,069. **Preserving and packing vegetables and fruit.** S. G. M. Nesbitt. November 30, 1925.

In preserving vegetable produce, including fruit, the produce is impregnated with a standard non-toxic alkaline buffer solution, so that peas, French beans, spinach, and other chlorophyll-containing produce will retain their colour when sterilized and packed in sealed containers. The treatment is preferably adjusted to give a liquor having a P_H value of 7·0-8·3 in the containers after sterilization. The protoplasm is first killed—*e.g.*, by scalding—to render the materials permeable to the buffer solution. A solution containing 4-8 parts by weight of sodium di-hydrogen phosphate to 100 parts of water may be used, or part of the phosphate may be replaced by an equivalent amount of sodium bicarbonate. A mixture of di-sodium hydrogen phosphate and sodium di-hydrogen phosphate may be employed when it is desired to vary the P_H value somewhat, more especially with produce not containing chlorophyll. For packing liquor, a 5 per cent. disodium hydrogen phosphate with the usual sugar-salt solution may be used, or a molecular equivalent of magnesium hydroxide may be employed. When permissible, soluble preservatives, such as benzoates or sulphites, or essential oils, such as cloves, cassia, etc., may be added to accelerate sterilization and to enable lower concentrations of the buffer solutions to be used. Examples are given of the packing of peas and spinach. Where a less bright colour is preferred a more dilute buffer solution is employed. In this case a small amount of sodium phosphate may be added. Impregnation with the solutions may be assisted by first reducing and then increasing the pressure.

266,101. **Bread, biscuits, etc.; ovens.** O. A. Elias. January 12, 1926.

The baking of biscuits, bread, cakes, etc., is carried out in the presence of artificially produced ultra-violet rays, the heating being preferably effected by one or more sources of both light and radiant heat.

266,139. **Vitamins.** A. W. Owe. March 2, 1926.

For vitaminizing an oil intended for food or medicine, a vitamin concentrate possessing objectionable flavour and smell is dissolved in the oil and the resulting solution is subjected to a mild refining treatment.

266,230. **Sausage-making machines; valves.** W. H. POTTER. September 8, 1926.

266,414. **Citric acid; alcohol.** A FERNBACH, J. L. YUILL, AND ROWNTREE AND CO., LTD. October 26, 1925.

The production of citric acid from solutions of sucrose by means of moulds or fungi is carried out without sterilization of the solution by heat but with the addition to the solution of hydrochloric acid, the amount of acid added being such as to establish a hydrogen ion concentration at which the selected organisms can be grown to the virtual exclusion of invading organisms; a suitable hydrogen ion concentration is P_H 1·8. In specification 266,415 the process is extended to include other carbohydrates and acids.

266,599. **Cutting caramels.** H. J. C. FORRESTER. July 20, 1926.

Relates to caramel cutting machines of the type in which candy dough is forced against cutters by presser feet and scored.

266,661. **Canisters.** W. PATON. April 20, 1926 (not yet accepted).

266,667. **Machines for casting chocolates.** BOGGILD AND JACOBSEN. October 5, 1926 (not yet accepted).

A machine for continuously casting chocolate, adjustable for different forms of chocolate, from pastilles to large cakes, comprises a uniformly moving endless belt carrying mould plates and an oscillating filling hopper. The mould plates are interchangeable, and the mechanism for oscillating the hopper and operating the filling pump is adjustable to suit the different forms of chocolates.

266,683. **Refrigerating.** I. AMUNDSEN. January 11, 1927 (not yet accepted).

Vacuum processes.—Alcohol, preferably methyl or ethyl alcohol, is used as the evaporating liquid in processes of the kind in which vapour from a liquid is alternately adsorbed in and released by heat from adsorbent substances such as activated carbon, silica gel, or bleaching powder. Activated animal carbon may be employed as the adsorbent.

266,684. **Acetic acid.** SOC. CHIMIQUE DES USINES DU RHONE. January 19, 1927 (not yet accepted).

Dilute aqueous acetic acid, containing cellulose compounds in solution, before being extracted with solvents is treated with substances having an acid function in order to render the cellulose compounds soluble in water and so prevent their precipitation while the acetic acid is being removed. According to examples, dilute acetic acid obtained in the manufacture of cellulose acetate is treated with sulphuric acid at elevated temperature for some hours. When necessary the sulphuric acid is neutralised with sodium carbonate before the extraction.

266,692. **Sour milk beverages.** S. MATSUBARA. February 9, 1927 (not yet accepted).

A sour milk beverage is produced by fermenting milk, adding a concentrated sugar solution, and then forcing the mixture by air which is under a pressure of the order of 5,000lbs. per sq. in. through an exceedingly small space between a resiliently supported valve and its seating. First cooled to 15° C. the original milk is sprayed through a fine nozzle, heated to about 70° C. and maintained at that temperature for about thirty minutes, cooled to 36° C., bacillus lacticum added and the temperature of 36° C. maintained for thirty hours; 35 per cent. of sterilized concentrated sugar solution is then added and the mixture cooled to 15° C., and finally the mass is forced through the valve to break up the globules of fat and to produce an emulsion.

Books Received

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